Safe Motherhood

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CHAPTER 5

Indirect maternal mortality increases in the Netherlands

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ABSTRACT

Objective: To assess causes, trends and substandard care in indirect maternal mortality in the Netherlands.
Design: Confidential enquiry into the causes of maternal mortality.
Setting: Nationwide in the Netherlands.
Population: 2.557.208 live births.
Methods: Data analysis of indirect maternal deaths in the period 1993-2005.
Main outcome measures: maternal mortality.
Results: 97 cases were classified as indirect deaths (23%), representing a Maternal Mortality Ratio of 3.3 per 100,000 live births, a statistically significant increase compared to the preceding Enquiry in the period 1983-1992 (MMR 2.4; OR 1.5, 95% CI 1.0-2.1). The percentage of cases not directly reported to the Dutch Maternal Mortality Committee was reduced from 15% to 5%. Cardiovascular disorders were the leading cause of indirect maternal mortality, followed by cerebrovascular disorders. Vascular dissection (*n*=19) was the most frequent specified cause of death. Risk factors were advanced maternal age, non-indigenous origin (Surinam and Dutch Antilles), and medical health risks before pregnancy. Substandard care was present in 35%, mainly being misjudgment of the severity of the condition and delay in starting therapy.
Conclusion: The reporting of cases by obstetric health care workers improved. The rise of mortality due to indirect causes is also considered a reflection of the change in risk profile of women of childbearing age and the result of demographic alterations concerning ethnicity and maternal age. The identification of high risk groups, preferably by programs of preconception care, should lead to improved care for these women, with a multidisciplinary approach when needed.

INTRODUCTION

Every year 535.900 women die worldwide as a result of their pregnancy. Less than 1% of maternal deaths occur in high income countries, representing the largest global public health discrepancy.[1] Worldwide, 20% of maternal deaths are due to indirect obstetric causes.[2]
Maternal mortality reflects access to and quality of maternal care, as well as the health status of women of reproductive age. It can be used for international

comparisons, but the varying level of reporting between countries makes it difficult to create a reliable estimate. In high-income countries, a reason for this difference between countries is that the certifying doctor fails to mention (recent) pregnancy on the death certificate, leading to underreporting in vital statistics.[3]
In the Netherlands, a periodically systematic national confidential enquiry of maternal deaths is published by the Dutch Maternal Mortality Committee (MMC). This committee was founded by the Netherlands Society of Obstetrics and Gynaecology in 1981. The first confidential enquiry included the period 1983-1992.[4] The second national enquiry covers the years 1993-2005.[5]
The confidential enquiry identifies the prevalence, causes and related substandard care factors associated with maternal mortality, providing more information than is generally available from vital statistics records. It shows a relatively low level of underreporting. This makes it possible to study the relation between pregnancy and associated diseases, to provide a systematic review of the main problems in overcoming maternal mortality. It highlights the key areas requiring recommendations for health sector and community action. The recommendations should result in improvement of care that pregnant and recently delivered women receive and in a further reduction of maternal mortality and morbidity.
In this paper we address the issue of indirect maternal mortality in the Netherlands during the time period 1993-2005.

MATERIALS AND METHODS

Data were collected as part of the Dutch nationwide Confidential Enquiry into Maternal Deaths. All pregnancy related deaths reported to the MMC during or within one year after pregnancy between 1993 and 2005 in the Netherlands were included in the study. The MMC comprises eight obstetricians and one internal medicine specialist working in the field of maternal medicine, appointed by the Dutch Society of Obstetrics and Gynaecology. The members are from both university and non-university hospitals. Maternal deaths were voluntarily reported to the MMC by obstetricians and in some cases by midwives and general practitioners. Additional cases were collected after a cross-check with the data collected by Statistics Netherlands, which collects all vital registration data from the Netherlands. Finally, a request to report every death during or within 1 year

after pregnancy in the study period was submitted to all 98 obstetrical departments in the Netherlands.
Maternal death was defined according to the World Health Organisation's International Classification of Diseases, tenth revision (ICD-10).[6] The Maternal Mortality Ratio (MMR) is defined as the number of maternal deaths per 100,000 live-born children up to 42 days after termination of pregnancy. Indirect obstetric deaths are those resulting from previously existing disease or disease that developed during pregnancy, not due to direct obstetric causes, but aggravated by the physiologic effects of pregnancy. Late maternal death was defined as the death of a woman from direct or indirect obstetric causes more than 42 days but less than one year after termination of pregnancy.
A single underlying cause and mode of death was assigned to each case by the committee. The underlying cause of death is the disease or injury which results directly in death or initiates the chain of events leading to death. The mode of death is the disease or injury that ends life directly.
On each case reported to the MMC a confidential enquiry was completed. Data were collected on a standard questionnaire including information concerning medical and obstetric histories, as well as the index pregnancy. Other sources of information such as antenatal charts, laboratory and bacteriological results, pathology and autopsy reports and professional correspondence were also analysed.
Substandard care was defined as all care factors which may have resulted in low standards of care and which had a probable negative influence on the chain of events leading directly to death. It could be assigned to any person involved in the care of pregnant women and to the pregnant woman herself. Avoidance of such factors did not necessarily mean that death would have been prevented. The standard of care was the care as stated in national guidelines. If there was no (applicable) guideline, the best available evidence was used. The anonymised cases were assessed for substandard care factors by the members of the MMC. Thereafter all cases were discussed at a group meeting for a final decision on classification and substandard care factors. In some cases, classification could be arbitrary. When consensus could not be reached, the decision was based on the assessment of the majority of the group.

Table I. Underlying causes of indirect maternal deaths[1] in the Netherlands, 1983-1992 vs 1993-2005

Underlying cause	1983-1992		1993-2005		OR (95% CI)
Live births:	1,860,807		2,557,208		
	n[1]	MMR[2]	*n*[1]	MMR[2]	
Cardiovascular disorders	13	0.6	45	1.6	2.5 (1.4-4.6)
- vascular dissection	-6		-19		
- cardiomyopathy	-2		-7		
- myocardial infarction	-1		-5		
- peri/myocarditis	-0		-4		
- other	-3		-4		
- congenital heart disease	-1		-6		
Cerebrovascular disorders	19	1.0	15	0.6	0.6 (0.3-1.1)
Infectious diseases	3	0.1	9	0.4	2.2 (0.6-7.5)
- Hepatitis	-1		-0		
- pneumonia	-1		-0		
- meningitis/encephalitis	-0		-3		
- renal	-0		-2		
- other	-1		-4		
Mental disorders	2	0.1	7	0.3	2.5 (0.6-10.8)
Diseases of blood (forming organs)	6	0.3	4	0.2	0.5 (0.1-1.6)
- sickle cell disease	-2		-1		
- TTP	-3		-1		
- Other	-1		-2		
Endocrine disorders	3	0.2	3	0.1	0.7 (0.2-3.2)
- diabetes mellitus	-1		-1		1
- pheochromocytoma	-2		-2		2
Pulmonary disorders	1	0.1	2	0.1	1.5 (0.2-11.1)
Miscellaneous	1	0.1	12[3]	0.3	8.7 (1.5-52.3)
Total	48	2.4	97	3.3	1.5 (1.0-2.1)

[1]n = number of deaths, late deaths included.
[2]MMR = Maternal Mortality Ratio: late deaths excluded.
[3]Miscellaneous: carcinoma (5), Steinert disease (1), Systemic Lupus Erythematosus (2), liver cirrhosis (1), HIV (1), neurological disorders (2).

RESULTS

In the study period, 414 deaths were identified. Of all cases, 97 (23%) were classified as indirect. Most indirect cases (*n*=93) were directly reported by obstetricians and midwives to the MMC. Four cases were only reported to Statistics Netherlands, only cause of death and age were available for these. The four cases were included in the totals, but could not be used for further analysis because of lack of other details. Of all indirect cases, 12 were classified as late maternal deaths, and not included in the calculation of the MMR. The MMR for indirect death was 3.3 per 100,000 live births (85/2,557,208). This represents a statistically significant rise compared with the period 1983-1992 with a MMR of 2.4 (OR 1.5; 95% CI 1.0-2.1).

The group of cardio- and cerebrovascular disorders accounted for 62% of indirect cases (Table I). Comparing the causes of maternal deaths with those from the preceding Enquiry, the MMR from cardiovascular disorders showed a statistically significant increase (MMR 1.6; OR 2.5, 95% CI 1.4-4.6).

Mean maternal age at death was 31.2 years. Women of 40 years and older face the highest risk (Table II), with a very high risk for women of 45 years and older (MMR 38.5; OR 15.2, 95% CI 2.6-89.3).

Impaired general health was observed in 51 (55%) of the women. In 84% the underlying cause of death was directly linked to the impaired general health. In four cases the specialist was known to have given a negative advice to become pregnant.

Table II. Indirect maternal death and live births in each age group with corresponding maternal mortality ratio (MMR), Statistics Netherlands data included; the Netherlands 1993-2005

Age (years)	Number of deaths[1]	Live births	MMR[2]	OR (95% CI)
15-19	3	29,364	10.2	4.0 (1.3-12.8)
20-24	8	230,812	3.5	1.4 (0.6-3.1)
25-29	19	749,981	2.5	1.0
30-34	33	1,045,676	3.2	1.2 (0.7-2.2)
35-39	22	436,089	5.0	2.0 (1.1-3.6)
≥40	8	65,286	12.3	4.8 (2.2-10.8)

[1]*n* = number of deaths (late deaths included).
[2]MMR = Maternal Mortality Ratio (late deaths excluded).

Table III. Indirect maternal death and parity in each age group with corresponding maternal mortality ratio (MMR), the Netherlands 1993-2005

Parity	*n*	Live births[a]	MMR	OR (95% CI)
0	45	1,168,068	3.9	1.3 (0.8-2.1)
1	27	924,351	2.9	1.0
2	10	326,278	3.1	1.0 (0.5-2.1)
3+	11	138,511	7.9	2.7 (1.4-5.4)

[a] Statistics Netherlands.

Table IV. Indirect maternal death and ethnicity, the Netherlands 1996-2005

Origin	*n*[1]	Live births[2]	MMR[3]	OR (95% CI)
Dutch native	72	1,516,332	4.2	1.0
Non-western immigrants	21	294,170	6.5	1.5 (0.9-2.4)
Surinam/Dutch Antilles	9	64,786	13.9	2.9 (1.5-5.8)
Turkey	5	66,925	6.0	1.6 (0.7-3.8)
Morocco	2	71,556	2.8	0.6 (0.2-2.2)
Other immigrants[4]	5	90,903	5.5	1.2 (0.5-2.8)

[1]*n* = number of deaths (late deaths included). [2]Statistics Netherlands.
[3]MMR calculated with number of deaths and live births between 1996-2005, Statistics Netherlands (late deaths excluded).
[4]Maternal deaths originating from sub-Saharan Africa, Asia; no subgroups defined by Statistics Netherlands.

From the start of pregnancy antenatal care was provided by an obstetrician in 52 cases (56%), compared to an average of 17% in the general pregnant population.

Women with parity three or more were at increased risk of indirect maternal mortality (Table III). Of the 48 multiparous women, 26 (54%) had a complicated obstetric history. Eleven women experienced either pregnancy-induced hypertension, pre-eclampsia or HELLP-syndrome (haemolysis, elevated liver enzymes and low platelet count) in a previous pregnancy. Other previous complications were caesarean section (*n*=7), postpartum haemorrhage (*n*=5), perinatal death or a child small for gestational age (*n*=5). Combining the numbers of impaired medical and obstetric health, only 10 women (11%) had an unrevealing history.

Twenty-one women were of non-indigenous origin (23%). The number of live born children from non-indigenous women was known only for the period 1996 to 2005, the MMR for this group could thus only be calculated for that period (Table IV). The MMR showed a trend of higher risk in non-indigenous deaths for indirect maternal death. The risk was statistically significantly higher for women from Surinam and the Dutch Antilles (OR 2.6; 95% 1.3-5.4). The mean age for non-indigenous women was 27.6 years, compared to 32.6 years for indigenous women. All women under the age of 20 were from non-indigenous origin. The number of non-indigenous

women who expected their third, fourth of fifth child was considerably higher, 24% versus 8% among indigenous women. Most women who died because of obstetric infectious diseases could be placed in the non-indigenous group (7 cases, 78%).
Twenty-six women delivered by caesarean section. In 15 women caesarean section was performed because of serious maternal disease already existing before the operation.
Of the 45 women dying from cardiovascular diseases 39 (87%) had acquired heart diseases. Death was mainly caused by vascular dissection (*n*=19), cardiomyopathy (*n*=7), myocardial infarction (*n*=5) and peri/myocarditis (*n*=4). Congenital heart disease was responsible for six deaths (13%). For complete analysis 42 cases (93%) were available. Twenty women in this group died antepartum (13 dissections) and five died more than 42 days postpartum. In 28 women (65%) risk factors for cardiovascular disease were present: maternal age above 35 years (*n*=17), chronic hypertension (*n*=10) and obesity (*n*=7).
Of the 15 women with cerebrovascular diseases 14 were available for further analysis. In eight women cerebrovascular disease occurred antepartum (57%), in four of these emergency caesarean section was performed for fetal indications. Three women had chronic hypertension (21%) and one had idiopathic thrombocytopenia. Six women were older than 35 years. None of the women dying from stroke had had a previous stroke.
Substandard care was identified in approximately one-third of all cases. In 21 cases (61%) substandard care was related to the obstetrician. In some cases, a woman in need of treatment by another specialist because of general health impairment, had a delayed referral to an obstetrician. Complaints initially were not recognized as being related to pregnancy early enough. In other cases the obstetrician misdiagnosed complaints, as being physiologic because of pregnancy, while referral to another specialist should have taken place. Health care workers in emergency departments misdiagnosed pregnant women with severe complications or did not consult their maternity colleagues. In 12 cases the patient herself contributed to substandard care, mainly by becoming pregnant against advice or discontinuing medication. Most substandard care was present in women suffering from cardiovascular disorders. Substandard care was judged to be present in 53% of the non-indigenous maternal deaths versus 26% in the Western group (OR 3.2; 95% CI 1.1-9.2).
The details of substandard care factors and other characteristics of indirect maternal deaths in the Netherlands in the period 1993-2005 are listed in Table V.

Table V. Some characteristics of 93 indirect maternal deaths in the Confidential Enquiry, the Netherlands 1993-2005

Factor	*n*		%	
Death during pregnancy	32		34%	
Death after pregnancy	61		66%	
Within 2 days		18		30%
Within 2-7 days		8		13%
Between 7 and 42 days		23		38%
Late deaths (>42 days)		12		20%
Health status before pregnancy				
General health impairment		47		51%
Obstetric health impairment		26		28%
Initial antenatal care by				
Midwife/general practioner		42		45%
Obstetrician		51		55%
Duration of pregnancy at time of delivery/death				
< 24 weeks		14		15%
24-28 weeks		6		6%
28-34 weeks		26		28%
34-37 weeks		15		16%
>37 weeks		32		34%
Death at home	12		13%	
Antepartum		6		50%
Within 6 weeks postpartum		2		17%
After 6 weeks postpartum		4		33%
Deliveries	58		62%	
Vaginal birth		32		55%
Spontaneous		29		50%
Caesarean section		26		45%
Miscarriage	3		3%	
Home birth	5		5%	
Perinatal mortality	45		48%	
Preterm delivery	25		27%	
Autopsy performed	46		49%	
Admission to intensive care unit	42		45%	
Substandard care factors present	33		35%	
Patient	12			
- Refusing advice		7		8%
- No use of prescribed medication		3		3%
- Other		2		2%

Table continues on next page.

Table V continued.

Factor	*n*	%
Midwifery care	5	
- Delay referral	3	3%
- Other	3	3%
Obstetrician	21	
- Delay diagnosis	10	11%
- Delay therapy	7	8%
- Other	7	8%
Other physician	2	2%

DISCUSSION

The most striking result of this enquiry was the significant increase of indirect maternal mortality. There are several possible explanations for this increase.
The percentage of mothers of age ≥ 35 at birth increased from 5.2% in 1980 to 20% in 2003 in the Netherlands.[7] Older women more often have previously existing medical disorders, such as hypertension, diabetes and obesitas, which all give higher risks in pregnancy.[8-11] In other countries, the influence of increased age on MMR is clearly noticed too.[12-14] Besides, women who could not or chose not to become pregnant in the past for chronical medical disorders can now make the conscious choice to do so. A high percentage of women was suffering from chronic medical health factors at the start of their pregnancy, putting them at higher risk for pregnancy complications. In 84% there was a direct link with the underlying cause of death. The physiological effects of pregnancy led to either aggravation or acceleration of the disease process, for example in the case of epilepsy or vascular dissection.
Ethnicity is one of the factors associated with maternal mortality. The number of non-indigenous women has shown a continuous increase in Dutch society.[7] In the period 1993-2005 21.5% of the total female population of the Netherlands was non-indigenous.[7] The MMR of non-indigenous women was not statistically significantly higher than the MMR of indigenous women (6.5 versus 4.2). Certain diseases and complications, such as infectious diseases have different distributions among both different ethnic and geographical groups.[15] Together with the higher prevalence of

impaired general health and the higher prevalence of communication problems between non-indigenous women and health care workers, this gives a possible explanation for the relatively high MMR for non-indigenous women. Women from Surinam and the Dutch Antilles had a statistically significantly higher risk. These women might be in poorer general health than women from other countries. In the Dutch report on all maternal deaths, a higher risk for women from Surinam and the Dutch Antilles was also found. In that report, also a higher risk was found for women originating from sub-Saharan Africa, but for indirect maternal death these women showed no increased risk.[5]

Finally, the greater awareness to report indirect maternal deaths led to a decrease in underreporting from 15% in the previous to 5% in the present report. Under-reporting was calculated using the cross-check with Statistics Netherlands in both enquiries. Cases not reported to both databases will still be missed. Comparison of the death register with the birth register has now become possible in the Netherlands, but with this cross-check only cause of death and age are available. It is thus not possible to analyse whether pregnancy was related to death in these cases, which might lead to overreporting.

Most women died of cardiovascular disorders. A multidisciplinary approach, if necessary at a specialized perinatal clinic, and increased antepartum surveillance is a must for pregnant women with known (congenital) cardiovascular disorders.[16]

Cerebrovascular accidents were reported by James et al. to occur equally divided between intrapartum and postpartum, with only 11% being antepartum.[17] This is not consistent with our data: in most women cerebrovascular disease occurred antepartum (57%).

Substandard care was identified in one-third of cases with indirect maternal mortality. This is lower than in all direct maternal deaths (61%)[5], and much lower than in deaths from pre-eclampsia (96%),[18] maybe because the underlying disease is known in most cases and treated. Delay in diagnosis, patient related factors and misjudgment by obstetricians or by other health care professionals played a role. This shows the extreme importance of coordinated multidisciplinary care for pregnant women. There was a significantly higher degree of substandard care in the population of non-indigenous origin. In the period 1983-1992 a higher degree of substandard care in this group was also reported,[19] but the recommendation to pay more attention to non-indigenous women did not lead to a decline in substandard care.

The only two other countries performing periodical nationwide comprehensive enquiries are the United Kingdom (UK)[20] and South Africa.[21] In both countries indirect maternal mortality shows an increase.

Higher age, obesity and death due to suicide seem to influence the prevalence in the UK. After 1985 the number of direct deaths has remained constant, resulting in indirect mortality exceeding direct mortality for the past three triennia. In the period 2003-2005, indirect MMR in the UK was 7.7 compared to a direct MMR of 6.2.[20] The rise in the UK is partially caused by an increase in deaths due to suicide. In the period 2000-2002, when late maternal deaths are included, psychiatric illness was the most frequent cause of maternal mortality. In the following period 2003-2005, a decline was seen, maybe due to implementation of the recommendations made in the previous report. In the Netherlands suicide is only considered indirect maternal mortality if the attending doctors assume a causal relationship, which might explain the relatively low level of psychiatric indirect deaths. Also, there might be onderreporting of these cases. [22]

In South Africa the increase of indirect maternal mortality lays in the rise of infectious diseases, particularly caused by the increasing impact of malaria and HIV/AIDS.[23,24]

The enquiry identified several risk factors for indirect maternal death and underlying factors related to substandard care. Knowing the major risk factors efforts may be put in place to prevent an increase of indirect maternal mortality in the future by identifying high risk groups. Obstetric care workers should be made aware of the risk factors and signs of the causes of indirect maternal death, in order to correctly diagnose and treat these conditions as early as possible. To study the effect of the implementation of these recommendations, trends concerning indirect mortality should be followed.

For women with chronic health factors, programs of preconception care should lead to improved care for these women, with a multidisciplinary approach when appropriate.

REFERENCES

1. Hill K, Thomas K, AbouZahr C, Walker N, Say L, Inoue M, Suzuki E, on behalf of the Maternal Mortality Working Group. Estimates of maternal mortality worldwide between 1990 and 2005: an assessment of available data. Lancet 2007;370:1311-9.
2. World Health Organisation. Reduction of maternal mortality: A joint WHO/UNFPA/UNIEF World Bank statement. Geneva, 1999.
3. Schuitemaker N, van Roosmalen J, Dekker G, van Dongen, P, van Geijn H, Bennebroek Gravenhorst J. Underreporting of Maternal Mortality in The Netherlands. Obstet Gynecol 1997; 90: 78-82.
4. Schuitemaker N, van Roosmalen J, Dekker G, van Dongen P, van Geijn H, Bennebroek Gravenhorst J. Confidential Enquiry into Maternal Deaths in The Netherlands 1983-1992. Eur J Obstet Gynecol Reprod Biol 1998;79:57-62.
5. Schutte JM, Steegers EAP, Schuitemaker NWE, Santema JG, de Boer K, et al. Rise in Maternal Mortality in The Netherlands. BJOG 2009, in press.
6. World Health Organisation. International Classification of Diseases, 10th Revision. Geneva: World Health Organisation, 1993.
7. Statistics Netherlands. Statline, Central Bureau of Statistics (CBS). Available online at: http://www.cbs.nl/en-GB/ (assessed at 1/12/08).
8. Dunne F. Type 2 diabetes and pregnancy. Seminars in Fetal and neonatal medicine 2005;10:333-9.
9. Weiss JL, Malone FD, Emig D, Ball RH, Nyberg DA, Comstock CH, et al. Obesity, obstetric complications and cesarean delivery rate. A population-based screening study. Am J Obstet Gynecol 2004;190:1091-7.
10. Brettingham M. Depression and obesity are major causes of maternal death in Britain. BMJ 2004;329:1205.
11. Hitchen L. More mothers are dying from causes related to obesity. BMJ 2007;335:1175.
12. Salanave B, Bouvier-Colle MH. Maternal Mortality and Birth Distribution: a Possible Explanation of Excess Mortality in France. Rev Epidemiol Sante Publique 1995;43:301-307.
13. Alexander S, Wildman K, Zhang W, Langer M, Vutuc C, Lindmark G. Maternal health outcomes in Europe. Eur J Obstet Gynecol Reprod Biol 2003; 111 Suppl 1: S78-S87.
14. Lewis G (ed) 2004. The Confidential Enquiry into Maternal and Child Health (CEMACH). Why mothers die 2000-2002. The sixth report on confidential enquiries into Maternal Deaths in the United Kingdom. London: CEMACH.
15. Wildschut HIJ. Sociodemographic factors: Age, parity, social class and ethnicity. In: High risk pregnancy. James OK, Seer PJ, Weiner CP and Gonik B. (Eds) 2nd Edn. WB Saunders, London, 1999:42.
16. Siu SC, Colman JM, Sorensen S, Smallhorn JF, Farine D, Amankwah KS, Spears JC, Sermer M. Adverse neonatal and cardiac outcomes are more common in pregnant women with cardiac disease. Circulation 2002;105:2179-84.
17. James AH, Beshnell CD, Jamison MG, et al. Incidence and risk factors for stroke in pregnancy and the puerperium. Obstet Gynecol 2005:106:509-16.
18. Schutte JM, Schuitemaker NW, van Roosmalen J, Steegers EA; Dutch Maternal Mortality Committee. Substandard care in maternal mortality due to hypertensive disease in pregnancy in the Netherlands. BJOG 2008:115;732-6.
19. Van Roosmalen J, Schuitemaker N, Brand R, van Dongen P, Bennebroek Gravenhorst J. Substandard Care in Immigrant versus Indigenous Maternal Deaths in The Netherlands. BJOG 2002;109:212-13.

20. Lewis G (ed) 2007. The Confidential Enquiry into Maternal and Child Health (CEMACH). Saving mothers' lives: reviewing maternal death to make motherhood safer – 2003-2005. The seventh report on confidential enquiries into Maternal Deaths in the United Kingdom. London: CEMACH.
21. Saving Mothers 1999-2001. Second Report on Confidential Enquiries into Maternal Deaths in South Africa. Pretoria, South Africa. Department of Health, 2002.
22. Schutte JM, Hink E, Heres MH, Wennink HJ, Honig A. Maternal mortality due to psychiatric disorders in The Netherlands. J Psychosom Obstet Gynecol 2008;29:150-2.
23. Kruger AM, Bhagwanjee S. HIV/AIDS: impact on maternal mortality at the Johannesburg Hospital, South Africa, 1995-2001. Int J Obstet Anesth 2003;12:164-8.
24. McIntyre J. Mothers infected with HIV. Br Med Bull 2003;67:127-35.